We have invited select authorities to present background information on challenging clinical problems and practical information on diagnosis and treatment for use by practitioners.

Diagnosis, Prevention, and Management of Eclampsia

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The pathogenesis of eclamptic convulsions remains unknown. Cerebral imaging suggests that cerebral abnormalities in eclampsia (mostly vasogenic edema) are similar to those found in hypertensive encephalopathy. However, cerebral imaging is not necessary for the diagnosis or management of most women with eclampsia. The onset of eclamptic convulsions can be antepartum (38–53%), intrapartum (18–36%), or postpartum (11–44%). Recent data reveal an increase in the proportion of women who develop eclampsia beyond 48 hours after delivery. Other than early detection of preeclampsia, there are no reliable tests or symptoms for predicting the development of eclampsia. In developed countries, the majority of cases reported in recent series are considered unpreventable. Magnesium sulfate is the drug of choice for reducing the rate of eclampsia developing intrapartum and immediately postpartum. There are 4 large randomized trials comparing magnesium sulfate with no treatment or placebo in patients with severe preeclampsia. The rate of eclampsia was significantly lower in those assigned to magnesium sulfate (0.6% versus 2.0%, relative risk 0.39, 95% confidence interval 0.28–0.55). Thus, the number of women needed to treat to prevent one case of eclampsia is 71. Magnesium sulfate is the drug of choice to prevent recurrent convulsions in eclampsia. The development of eclampsia is associated with increased risk of adverse outcome for both mother and fetus, particularly in the developing nations. Pregnancies complicated by eclampsia require a well-formulated management plan. Women with a history of eclampsia are at increased risk of eclampsia (1–2%) and preeclampsia (22–35%) in subsequent pregnancies. Recommendations for diagnosis, prevention, management, and counseling of these women are provided based on results of recent studies and my own clinical experience. (Obstet Gynecol 2005;105:402–10. © 2005 by The American College of Obstetricians and Gynecologists.)

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Eclampsia is defined as the development of convulsions and/or unexplained coma during pregnancy or postpartum in patients with signs and symptoms of preeclampsia. In the Western world, the reported incidence of eclampsia ranges from 1 in 2,000 to 1 in 3,448 pregnancies.[1–3] The reported incidence is usually higher in tertiary referral centers, in multifetal gestation, and in populations with no prenatal care.[4,5]

PATHOPHYSIOLOGY

The pathogenesis of eclamptic convulsions continues to be the subject of extensive investigation and speculation. Several theories and etiologic mechanisms have been implicated as possible etiologic factors, but none of these have been conclusively proven. Some of the etiologic mechanisms that are implicated in the pathogenesis of eclamptic convulsions have included cerebral vasoconstriction or vasospasm hypertensive encephalopathy, cerebral edema or infarction, cerebral hemorrhage, and metabolic encephalopathy. However, it is not clear whether these findings are causes or an effects of the convulsions.

DIAGNOSIS

The diagnosis of eclampsia is secure in the presence of generalized edema, hypertension, proteinuria, and convulsions. However, women in whom eclampsia develops exhibit a wide spectrum of signs, ranging from severe hypertension, severe proteinuria, and generalized edema to absent or minimal hypertension, no proteinuria, and no edema.[5] Hypertension is considered the hallmark for the diagnosis of eclampsia. The hypertension can be severe (at least 160 mm Hg systolic and/or at least 110 mm Hg diastolic) in 20–54% of cases[3,6] or mild (systolic blood pressure between 140 and 160 mm Hg or diastolic blood pressure between 90 and 110 mm Hg) in 30–60% of cases.[3,6] However, in 16% of the cases, hypertension may be absent.[6] In addition, severe hypertension is more

Table 1. Symptoms in Women With Eclampsia

Symptom	Study		
	Douglas and Redman[3] (N = 325)	Katz et al[7] (N = 53)	Chames et al[8] (N = 89)
Headache	50	64	70
Visual changes	19	32	30
RUQ/epigastric pain	19	Not reported	12
At least one of the above	59	Not reported	75

RUQ, right upper quadrant.

Data are presented as percentage.

common in patients who develop antepartum eclampsia (58%) and in those who develop eclampsia at 32 weeks of gestation or earlier (71%).[6] Moreover, hypertension is absent in only 10% of women who develop eclampsia at or before 32 weeks of gestation.[6]

The diagnosis of eclampsia is usually associated with proteinuria (at least 1+ on dipstick).[5,6] In a series of 399 women with eclampsia studied by the author, substantial proteinuria (≥ 3+ on dipstick) was present in only 48% of the cases, whereas proteinuria was absent in 14% of the cases.[6] Abnormal weight gain (with or without clinical edema) in excess of 2 pounds per week during the third trimester might be the first sign before the onset of eclampsia, but edema was absent in 26% of 399 eclamptic women studied by the author.[6]

Several clinical symptoms are potentially helpful in establishing the diagnosis of eclampsia. These symptoms may occur before or after the onset of convulsions, and they include persistent occipital or frontal headaches, blurred vision, photophobia, epigastric and/or right upper-quadrant pain, and altered mental status. Patients will have at least one of these symptoms in 59–75% of the cases (Table 1).[3,7,8] Headaches are reported by 50–75% of the patients, whereas visual changes are reported in 19–32% of the patients.[3,7,8]

TIME OF ONSET OF ECLAMPSIA

The onset of eclamptic convulsions can be antepartum, intrapartum, or postpartum. The reported frequency of

antepartum convulsions among recent series has ranged from 38% to 53% (Table 2)[3,6–8] The frequency of postpartum eclampsia has ranged from 11% to 44%.[3,6–8] Although most cases of postpartum eclampsia occur within the first 48 hours, some cases can develop beyond 48 hours postpartum and have been reported as late as 23 days postpartum.[6,8,9] In the latter cases, an extensive neurological evaluation is needed to rule out the presence of other cerebral pathology.[8,9] This evaluation should include neurologic examination, brain imaging, cerebrovascular testing, lumbar puncture, and blood tests, as needed.

Almost all cases (91%) of eclampsia develop at or beyond 28 weeks.[6] The remaining cases occur between 21 and 27 weeks of gestation (7.5%) or at 20 weeks of gestation or earlier (1.5%).[6] Eclampsia occurring before the 20th week of gestation has usually been reported with molar or hydropic degeneration of the placenta, with or without a coexistent fetus.[10,11] Although rare, eclampsia occurring during the first half of pregnancy without molar degeneration of the placenta has been described in case reports.[6,10] These women may be misdiagnosed as having hypertensive encephalopathy, seizure disorder, or thrombotic thrombocytopenic purpura. Women in whom convulsions develop in association with hypertension and proteinuria during the first half of pregnancy should be considered to have eclampsia until proven otherwise. These women should have ultrasound examination of the uterus to rule out molar pregnancy and/or hydropic or cystic degeneration of the

Table 2. Time of Onset of Eclampsia in Relation to Delivery

	Study			
	Douglas and Redman[3] (N = 383)	Katz et al[7] (N = 53)	Mattar and Sibai[6] (N = 399)	Chames et al[8] (N = 89)
Antepartum	38	53	53	67*
Intrapartum	18	36	19	. . .
Postpartum	44	11	28	33
≤ 48 h	39	5	11	7
> 48 h	5	6	17	26

Data are presented as percentage.

* Includes antepartum and intrapartum cases.

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placenta. They also should have extensive neurologic and medical evaluation to rule out other pathology such as brain tumors, encephalitis, meningitis, cerebral hemorrhage or thrombosis, cerebral angitis, thrombotic thrombocytopenia purpura, or metabolic diseases.

Late postpartum eclampsia is defined as eclampsia that occurs more than 48 hours, but less than 4 weeks, after delivery.[9] Historically, eclampsia was believed not to occur more than 48 hours after delivery,[9] but several recent reports have confirmed the existence of late postpartum eclampsia.[3,8,9] These women will have signs and symptoms consistent with preeclampsia in association with convulsions.[8,9] Some of these women will demonstrate a clinical picture of preeclampsia during labor or immediately postpartum (56%), whereas others will demonstrate these clinical findings for the first time more than 48 hours after delivery (44%).[9] Of interest is the fact that late postpartum eclampsia developed despite the use of prophylactic magnesium during labor and for at least 24 hours postpartum in previously diagnosed preeclamptic women.[8,9] Therefore, women in whom convulsions develop in association with hypertension and/or proteinuria or with headaches or blurred vision after 48 hours of delivery should be considered to have eclampsia and initially treated as such.[8,9]

CEREBRAL PATHOLOGY IN ECLAMPSIA

The cause of eclampsia is unknown, and there are many unanswered questions regarding the pathogenesis of its cerebral manifestations. Cerebral pathology in cortical and subcortical white matter in the form of edema, infarction, and hemorrhage (microhemorrhage and intracerebral parenchymal hemorrhage) is a common autopsy finding in patients who die from eclampsia.[12–14] Although autopsy series provide information regarding the central nervous system abnormality in patients dying of eclampsia, this information is not necessarily indicative of the central nervous system abnormality present in the majority of patients who survive this condition.[15] The diagnosis of eclampsia is not dependent on any single clinical or diagnostic neurologic findings. Focal neurologic signs such as hemiparesis or unconscious state are rare in large eclampsia series reported from the developed countries.[13,16,17] Although eclamptic patients may initially manifest a variety of neurologic abnormalities, including cortical blindness, focal motor deficits, and coma, most of them have no permanent neurologic deficits.[15,17] These neurologic abnormalities are probably due to a transient insult, such as hypoxia, ischemia, or edema.[15]

Several neurodiagnostic tests such as electroencephalography (EEG), computed axial tomographic scan (CT), cerebral Doppler velocimetry, magnetic resonance imaging (MRI), and cerebral angiography (both traditional and MRI angiography) have been studied in women with eclampsia. The results of these studies have been reviewed elsewhere and will not be discussed here.[18] In general, the EEG is acutely abnormal in the majority of eclamptic patients, but these abnormalities are not pathognomic of eclampsia. In addition, the abnormal EEG findings are not affected by the use of magnesium sulfate.[18] Moreover, lumbar puncture is not helpful in the diagnosis and management of eclamptic women. The results of CT and MRI reveal the presence of edema and infarction within the subcortical white matter and adjacent gray matter, mostly in the parieto-occipital lobes in approximately 50% of cases.[15,18–20] Cerebral angiography and Doppler velocimetry suggest the presence of vasospasm.[18,21]

On the basis of cerebral imaging findings, attention has been directed to hypertensive encephalopathy as a model for the central nervous system abnormalities in eclampsia. The 2 conditions share many clinical, radiologic, and pathologic features.[15,19,20] There is failure of normal cerebral blood flow autoregulation in patients with hypertensive encephalopathy and in some patients with eclampsia.[15,18–23] Two theories have been proposed to explain these cerebral abnormalities: forced dilation and vasospasm.[15] The forced dilation theory suggests that the lesions in eclampsia are caused by loss of cerebrovascular autoregulation. At increased arterial pressures, normal cerebral vasoconstriction initially occurs. However, when the upper limit of autoregulation is reached, cerebral vasodilation starts to occur, allowing local hyperperfusion with subsequent interstitial or vasogenic edema.[15] According to the vasospasm theory, cerebral overregulation occurs in response to acute severe hypertension with resultant ischemia, cytotoxic edema, and infarction.[15,18–21] In summary, most women with eclampsia will have evidence of vasogenic edema on brain imaging. This suggests that hypertensive encephalopathy plays a central role in the pathogenesis of eclamptic convulsions.

Recently, various forms of brain imaging were used to characterize the relative frequency of vasogenic and cytotoxic edema in 2 small series of eclamptic women.[22,23] Cerebral edema (mostly vasogenic) was present in up to 93–100% of these women.[22,23] However, concurrent foci of infarction were present in 6 of 27 eclamptic women studied by Zeeman et al[22] and in 3 of 17 eclamptic and preeclamptic women studied by Loureiro et al.[23] In addition, 5 of these 6 women reported by Zeeman et al had persistent abnormalities on repeat MRI testing 6–8 weeks later, suggesting that these lesions might not be reversible.[22] Moreover, 4 of the 17 women reported by Loureiro et al had persistent MRI abnormalities at a follow-up at 8 weeks (median).[23]

In summary, cerebral imaging findings in eclampsia are similar to those found in patients with hypertensive encephalopathy. Cerebral imaging is not necessary for the diagnosis and management of most women with eclampsia. Cerebral imaging is indicated for patients with focal neurologic deficits or prolonged coma. In these patients, hemorrhage and other serious abnormalities requiring specific pharmacologic therapy or surgery must be excluded. Cerebral imaging may also be helpful in patients who have atypical presentation for eclampsia (onset before 20 weeks of gestation or more than 48 hours after delivery, and eclampsia refractory to adequate magnesium sulfate therapy).[18] It is hoped that advances in MRI and MR angiography as well as in cerebral vascular Doppler velocimetry will aid our understanding of the pathogenesis of this condition and thus improve long-term outcome.

DIFFERENTIAL DIAGNOSIS

The presenting symptoms, clinical findings, and many of the laboratory findings overlap with a number of medical and surgical conditions.[9,24–26] The most common cause of convulsions developing in association with hypertension and/or proteinuria during pregnancy or immediately postpartum is eclampsia. Rarely, other etiologies producing convulsions in pregnancy or postpartum may mimic eclampsia (see box).

DIFFERENTIAL DIAGNOSIS OF ECLAMPSIA

☐ Cerebrovascular accidents
  ● Hemorrhage
  ● Ruptured aneurysm or malformation
  ● Arterial embolism or thrombosis
  ● Cerebral venous thrombosis
  ● Hypoxic ischemic encephalopathy
  ● Angiomas
☐ Hypertensive encephalopathy
☐ Seizure disorder
☐ Previously undiagnosed brain tumors
☐ Metastatic gestational trophoblastic disease
☐ Metabolic diseases
  ● Hypoglycemia, hyponatremia
☐ Reversible posterior leukoencephalopathy syndrome
☐ Thrombophilia
☐ Thrombotic thrombocytopenic purpura
☐ Postdural puncture syndrome
☐ Cerebral vasculitis

These diagnoses are particularly important in the presence of focal neurologic deficits, prolonged coma, or atypical eclampsia. In addition, in some patients gestational hypertension or preeclampsia may develop in association with these disorders (connective tissue disease, thrombophilias, seizure disorder, hypertensive encephalopathy), further contributing to the diagnostic difficulty.[24] Therefore, an effort should be made to identify an accurate diagnosis, given that management strategies may differ among these conditions. The diagnosis and management of the conditions that mimic eclampsia are beyond the scope of this report.

MATERNAL AND PERINATAL OUTCOME

Although eclampsia is associated with an increased risk of maternal death in developed countries (0–1.8%),[2,3,6–8,16,27] the mortality rate is as high as 14% in developing countries.[13,14,28] The high maternal mortality reported from the developing countries was noted primarily among patients who had multiple seizures outside the hospital and those without prenatal care.[7] In addition, this high mortality rate could be attributed to the lack of resources and intensive care facilities needed to manage maternal complications from eclampsia.[5] A recent review of all reported pregnancy-related deaths in the United States for the years 1979–1992 identified 4,024 pregnancy-related deaths.[29] A total of 790 (19.6%) were considered due to preeclampsia-eclampsia, with 49% of these 790 considered related to eclampsia. The authors found that the risk of death from preeclampsia or eclampsia was higher for women older than 30 years and those with no prenatal care, as well as for black women. The greatest risk of death was found among women with pregnancies at or before 28 weeks of gestation.[29]

Pregnancies complicated by eclampsia are also associated with increased rates of maternal morbidities, such as abruptio placentae (7–10%),[3,6,14] disseminated intravascular coagulopathy (7–11%),[3,6,14] pulmonary edema (3–5%), acute renal failure (5–9%), aspiration pneumonia (2–3%), and cardiopulmonary arrest (2–5%).[3,6,14] Adult respiratory distress syndrome and intracerebral hemorrhage are rare complications among eclamptic series reported from the developed world.[3,6–8,16] The risks of diffuse intravascular coagulation (8%); hemolysis, elevated liver enzymes, low platelets (HELLP) syndrome (10–15%); and liver hematoma (1%) are similar in eclamptic and severely preeclamptic patients. It is important to note that maternal complications are significantly higher among women who develop antepartum eclampsia, particularly among those who develop eclampsia remote from term.[3,6,14]

Perinatal mortality and morbidities remain high in eclamptic pregnancies. The reported perinatal death rate in recent series ranged from 5.6% to 11.8%.[3,5,27] This high perinatal death rate is related to prematurity, abruptio placentae, and severe fetal growth restriction.[3,5] The rate of preterm delivery is approximately 50%, with approximately 25% of these occurring before 32 weeks of gestation.[3,5,8]

IS ECLAMPSIA PREVENTABLE?

Because we do not know the pathogenesis of eclampsia, our strategies for prevention are limited. Given this situation, our focus for prevention can be primary by preventing the development of preeclampsia or secondary by using pharmacologic agents that prevent convulsions in women with established preeclampsia. Prevention can also be tertiary by preventing subsequent convulsions in women with established eclampsia. Currently, there is no preventive therapy for preeclampsia. During the past decade, several randomized trials reported on the use of protein or salt-restricting zinc, magnesium, or fish oil supplementation, low-dose aspirin, calcium, and vitamin C and E in women with various risk factors to reduce the rate or severity of preeclampsia.[30] The results of these studies were the subject of a recent review. In general, the results of the above trials revealed minimal or no benefit in reduction of preeclampsia.[30] Even in studies reporting a reduction in the rate of preeclampsia, there was no benefit in perinatal outcome.[30]

Current management schemes designed to prevent eclampsia are based on early detection of gestational hypertension or preeclampsia and subsequent use of preventive therapy in such women.[7,27,31,32] Some of the recommended preventive therapies have included close monitoring (in-hospital or outpatient), use of antihypertensive therapy to keep maternal blood pressure below a certain level (less than severe range or to normal values), timely delivery, and prophylactic use of magnesium sulfate during labor and immediately postpartum in those considered to have preeclampsia.[33] These management schemes assume that the clinical course in the development of eclampsia is characterized by a gradual process that begins with progressive weight gain followed by hypertension (mild to severe) and proteinuria, which is followed by the onset of premonitory symptoms, and ends with the onset of generalized convulsions or coma.[7,31] This clinical course may be true in some women who develop eclampsia in the developed countries, but recent data from large series of eclamptic women from the United States and Europe indicate that approximately 20% of eclamptic women do not have any premonitory signs or symptoms before the onset of convulsions.[3,5–7,31,32] In addition, in many of these women the onset of convulsions was abrupt and did not follow the presumed progression from mild to severe disease before onset of eclampsia.[3,5–7,31]

It is also assumed that appropriate and timely standard preventive therapy will avert eclampsia in virtually all patients with gestational hypertension-preeclampsia.[3,7,31,32] There are no randomized trials evaluating the efficacy of in-hospital management of patients with gestational hypertension or preeclampsia for the prevention of eclampsia. Nevertheless, the data from retrospective studies from the developed countries indicate that approximately 50% of eclamptic women developed their first convulsion while in the hospital under "close medical supervision."[3,7,31,32] Thus, it is doubtful that early and prolonged hospitalization of women with mild hypertension or preeclampsia will prevent eclampsia. For this reason, I do not recommend prolonged hospitalization for women with gestational hypertension. All women with mild gestational hypertension can safely be managed on an ambulatory basis.

There are several randomized trials comparing the use of antihypertensive drugs with the use of no treatment or a placebo in the management of patients with mild hypertension or preeclampsia.[34] Overall, these trials revealed lower rates of progression to severe disease. Of note, the study design and sample size of these trials were inadequate to evaluate benefits regarding prevention of eclampsia.[34] Currently, I do not recommend antihypertensive medications during expectant management of women with mild gestational hypertension or preeclampsia.

Prophylactic magnesium sulfate is recommended only for women who are hospitalized with established diagnoses of preeclampsia.[33] Its use is recommended only during labor and for 12–24 hours postpartum.[33] Therefore, it can be expected to have a potential effect in preventing eclampsia that develops only during this time period. There are 4 randomized trials comparing the use of magnesium sulfate with the use of no treatment or placebo for the prevention of convulsions in patients with severe preeclampsia.[35,36] Antihypertensive medications were also used in the majority of patients studied in both groups. The rate of eclampsia was significantly lower in those assigned to magnesium sulfate (0.6% versus 2.0%, relative risk [RR] 0.39, 95% confidence interval [CI] 0.28–0.55).[35] Thus, 71 women with severe preeclampsia need to be treated to prevent one case of eclampsia. The Magpie trial[36] provided data about the rate of eclampsia according to the countries participating in the trial (developing or developed countries), as well as according to the presence or absence of imminent eclampsia (severe headaches, blurred vision, or epigastric pain). In those who had imminent eclampsia, the

number needed to be treated to prevent one case of eclampsia was 36. In contrast, in those without symptoms, the number of women needed to treat to prevent one case of eclampsia was 129. Among those enrolled in the developed countries, the number of women needed to be treated to prevent one case was 385.[36] On the other hand, there are inadequate data to evaluate the efficacy of magnesium sulfate in preventing convulsions in patients with mild preeclampsia.[35] Thus, the evidence to date does not justify routine use of magnesium sulfate prophylaxis in women with mild preeclampsia.

There are several randomized trials comparing the efficacy of magnesium sulfate with other anticonvulsive agents for the prevention of recurrent seizures in women with eclampsia.[37] In these trials, magnesium sulfate was compared with diazepam, phenytoin, or a lytic cocktail (pethidine, chlorpromazine, and promethazine). Overall, these trials revealed that magnesium sulfate was associated with a significantly lower rate of recurrent seizures (9.4% versus 23.1%, RR 0.41, 95% CI 0.32–0.51) and a lower rate of maternal death (3.0% versus 4.8%, RR 0.62, 95% CI 0.39–0.99) than that observed with other agents.[37]

The low incidence of eclampsia in the developed countries is probably related to prevention of cases of eclampsia in women with a classic presentation and with a classic progression from mild to severe preeclampsia.[3,7] As a result, the majority of eclamptic cases described in reported series from the United States and Europe were found to have atypical presentation (abrupt onset, development of convulsions while receiving prophylactic magnesium sulfate, or onset of convulsions beyond 48 hours after delivery).[2,3,5–9,31,32] Indeed, most of eclamptic convulsions in these series developed in hospitalized women, and in some of these women the onset of convulsions was not preceded by warning signs or symptoms.[3,7,31,32] Overall, the percentage of eclampsia considered unpreventable in these series ranged from 31% to 87%.[2,3,31,32]

RECOMMENDED MANAGEMENT

The first priority in the management of eclampsia is to prevent maternal injury and to support respiratory and cardiovascular functions. During or immediately after the acute convulsive episode, supportive care should be given to prevent serious maternal injury and aspiration, assess and establish airway potency, and insure maternal oxygenation. During this time, the bed's side rails should be elevated and padded, a padded tongue blade is inserted between the teeth (avoid inducing gag reflex), and physical restraints may be needed.[18] To minimize the risk of aspiration, the patient should lie in lateral decubitus position, and vomitus and oral secretion are suctioned as needed.

During the convulsive episode, hypoventilation and respiratory acidosis often occur. Although the initial seizure lasts only a few minutes, it is important to maintain oxygenation by supplemental oxygen administration via a face mask with or without oxygen reservoir at 8–10 L/min.[18] After the convulsion has ceased, the patient begins to breathe again and oxygenation is rarely a problem. However, maternal hypoxemia and acidosis may develop in women who have had repetitive convulsions and in those with aspiration pneumonia, pulmonary edema, or a combination of these factors. It is my policy to use transcutaneous pulse oximetry to monitor oxygenation in all eclamptic patients. Arterial blood gas analysis is required if the pulse oximetry results are abnormal (oxygen saturation at or below 92%).

The next step in the management of eclampsia is to prevent recurrent convulsions. Magnesium sulfate is the drug of choice to treat and prevent subsequent convulsions in women with eclampsia.[37] My policy is to give a loading dose of 6 g over 15–20 minutes, followed by a maintenance dose of 2 g/h as a continuous intravenous infusion. Serum magnesium levels are not monitored during the infusion because there is no established serum magnesium level that is considered "therapeutic." Serum magnesium levels require monitoring in the presence of renal dysfunction and/or when there are absent reflexes. Approximately 10% of eclamptic women will have a second convulsion after receiving magnesium sulfate.[28,37] In these women, another bolus of 2 g magnesium sulfate can be given intravenously over 3–5 minutes. An occasional patient will have recurrent convulsions while receiving adequate doses of magnesium sulfate. In this patient, recurrent seizures can be treated with sodium amobarbital, 250 mg intravenously over 3–5 minutes.[18]

The next step in the management of eclampsia is to reduce the blood pressure to a safe range but at the same time avoid significant hypotension. The objective of treating severe hypertension is to avoid loss of cerebral autoregulation and to prevent congestive heart failure without compromising cerebral perfusion or jeopardizing uteroplacental blood flow that is already reduced in many women with eclampsia.[18] My policy is to keep systolic blood pressure between 140 and 160 mm Hg and diastolic blood pressure between 90 and 110 mm Hg. The rationale for keeping maternal blood pressures at these levels is to avoid potential reduction in either uteroplacental blood flow or cerebral perfusion pressure. This can be achieved with bolus of 5–10 mg doses of hydralazine or labetalol (20–40 mg intravenously) every 15 minutes, as needed,[33] or 10–20 mg of nifedipine orally every 30 minutes for a maximum dose of 50 mg in

one hour. Other potent antihypertensive medications such as sodium nitroprusside or nitroglycerine are rarely needed in eclampsia. Diuretics are not used except in the presence of pulmonary edema.

Maternal hypoxemia and hypercarbia cause fetal heart rate and uterine activity changes during and immediately following a convulsion. Fetal heart rate changes can include bradycardia, transient late decelerations, decreased beat-to-beat variability, and compensatory tachycardia. Changes in uterine activity can include increased frequency and tone.[38] These changes usually resolve spontaneously within 3–10 minutes after the termination of convulsions and the correction of maternal hypoxemia. The patient should not be rushed for an emergency cesarean delivery based on these findings, especially if the maternal condition is not stable. It is considered to be advantageous to the fetus to allow in utero recovery from hypoxia and hypercarbia due to maternal convulsions. However, if the bradycardia and/or recurrent late decelerations persist beyond 10–15 minutes despite all resuscitive efforts, then a diagnosis of abruptio placentae or nonreassuring fetal status should be considered.

The presence of eclampsia is not an indication for cesarean delivery. The decision to perform cesarean delivery should be based on fetal gestational age, fetal condition, presence of labor, and cervical Bishop score.[33] My policy is to recommend cesarean delivery for those with eclampsia before 30 weeks of gestation who are not in labor and whose Bishop score is below 5. Patients having labor or rupture of membranes are allowed to deliver vaginally in the absence of obstetric complications. When labor is indicated, it is initiated with either oxytocin infusions or prostaglandins in all patients with a gestational age of 30 weeks or more, irrespective of the Bishop score. A similar approach is used for those before 30 weeks of gestation if the cervical Bishop score is at least 5.

Maternal pain relief during labor and delivery can be provided by either systemic opioids or epidural anesthesia as recommended for women with severe preeclampsia.[33] Either epidural, spinal, or combined techniques of regional anesthesia can be used for cesarean delivery. Regional anesthesia is contraindicated in the presence of coagulopathy or severe thrombocytopenia (platelet count less than 50,000/mm^3). In women with eclampsia, general anesthesia increases the risk of aspiration and failed intubation due to airway edema and is associated with marked increases in systemic and cerebral pressures during intubation and extubation.[33] Women with airway or laryngeal edema may require awake intubation under fiber optic observation with the availability of immediate tracheostomy. Changes in systemic or cerebral pressures may be attenuated by pretreatment with labetalol or nitroglycerine injections.[33]

POSTPARTUM MANAGEMENT

After delivery, patients with eclampsia should receive close monitoring of vital signs, fluid intake and output, and symptoms for at least 48 hours. These women usually receive large amounts of intravenous fluids during labor, delivery, and postpartum. In addition, during the postpartum period there is mobilization of extracellular fluid leading to increased intravascular volume. As a result, women with eclampsia, particularly those with abnormal renal function, those with abruptio placentae, and those with preexisting chronic hypertension, are at increased risk for pulmonary edema and exacerbation of severe hypertension postpartum.[6,39] These women should receive frequent evaluation of the amount of intravenous fluids, oral intake, blood products, and urine output, as well as monitoring by pulse oximetry and pulmonary auscultation.

Parenteral magnesium sulfate should be continued for at least 24 hours after delivery and/or for at least 24 hours after the last convulsion. If the patient has oliguria (less than 100 mL/4 h), the rate of both fluid administration and the dose of magnesium sulfate should be reduced. Once delivery has occurred, other oral antihypertensive agents such as labetalol or nifedipine can be used to keep systolic blood pressure below 155 mm Hg and diastolic blood pressure below 105 mm Hg. The recommended dose of oral labetalol is 200 mg every 8 hours (maximum dose of 2,400 mg/d), and the recommended dose of nifedipine is 10 mg orally every 6 hours (maximum dose of 120 mg/d). My drug of choice is oral nifedipine because it offers the benefit of improved diuresis in the postpartum period.[40]

The simultaneous use of short-acting nifedipine and magnesium sulfate was associated with profound neuro-

Table 3. Recurrent Preeclampsia-Eclampsia in Subsequent Pregnancies in Women With Previous Eclampsia

Subsequent Pregnancies	Study			
	Chesley[44]	Lopez-Llera and Horton[45]	Adelusi and Ojengbede[46]	Sibai et al[17]
Number of women	171	110	64	182
Number of pregnancies	398	110	64	366
Eclampsia (%)	1.0	. . .	15.6	1.9
Preeclampsia (%)	23	35	27	22

muscular blockade (cardiac depression, muscle weakness) in 2 case reports.[41,42] However, no such blockade was reported in the Magpie trial[36] in which 1,469 women assigned to receive magnesium sulfate also received nifedipine. In addition, no neuromuscular blockade was reported in any of the trials comparing hydralazine with nifedipine, in which there was simultaneous use of magnesium sulfate.[43] Moreover, I have not encountered a single case of neuromuscular blockade during a 10-year experience with simultaneous use of nifedipine and magnesium sulfate in women with preeclampsia-eclampsia or preterm labor. Nevertheless, the development of excessive neuromuscular blockade can be reversed with the administration of one gram of 10% solution calcium gluconate.

SUBSEQUENT PREGNANCY OUTCOME AND REMOTE PROGNOSIS

Pregnancies complicated by eclampsia may be associated with life-threatening complications for both the mother and infant. Therefore, clinicians should be prepared to answer questions regarding subsequent pregnancy outcome and long-term prognosis. Women with a history of eclampsia are at increased risk of all forms of preeclampsia in subsequent pregnancies (Table 3).[17,44–46] In general, the rate of preeclampsia in subsequent pregnancies is approximately 25%, with substantially higher rates if the onset of eclampsia was in the second trimester. The rate of recurrent eclampsia is approximately 2%. Because of these risks, these women should be informed that they are at increased risk for adverse pregnancy outcome in subsequent pregnancies.[17,47] Currently, there is no preventive therapy for recurrent antepartum eclampsia.

The long-term effects of eclampsia on maternal blood pressure and neurologic outcome have been the subject of few reports.[17,44,48] The findings of these reports revealed that eclampsia did not cause hypertension in women who were normotensive before the eclamptic pregnancy. Two of these studies found that the rate of chronic hypertension on follow-up was significantly higher in those who had eclampsia remote from term than in those who had eclampsia at 37 weeks of gestation or later.[17,44] In addition, one of these studies revealed that women who had eclampsia as multiparas were at increased risk of death from cardiovascular renal disease.[44] Moreover, these studies revealed no evidence of neurologic deficit during the follow-up period.[17,44]

SUMMARY

The pathogenesis of eclamptic convulsions remains unknown. Despite all the recent research efforts, there are no reliable tests or signs to predict the development of eclampsia in women with preeclampsia. There are no effective therapeutic methods to prevent antepartum eclampsia or eclampsia developing more than 48 hours after delivery. Prophylactic magnesium sulfate is effective in preventing approximately 50% of the cases of eclampsia developing in labor or immediately postpartum in women with diagnosed preeclampsia. Pregnancies complicated by eclampsia require a well-formulated management plan.

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